locally between the labour exchanges and the education authority, so that no actual overlapping of work shall take place, but each be helpful to the other.

THE annual prize distribution of the Sir John Cass Technical Institute was held on Tuesday, November 29, when Sir William Tilden distributed the prizes and delivered an address; the chair was taken by Sir Owen Roberts, chairman of the governing body. Sir William Tilden, after contrasting the conditions available for obtaining scientific instruction now, in such institutions as that of the Sir John Cass, as compared with his own student days, referred especially to the improved character of the teaching, but pointed out that the responsibility for gaining the full benefit of these advantages rested still, as it did in former years, far more with the students than with the teachers. Whilst the business of the teachers was to be regarded as being concerned with the selection of the subjects to be studied rather than their exposition, the real responsibility for progress must always rest with the student. The assimilation of knowledge is the business of the student, and the greatest inducement and stimulus for such assimilation is the desire for knowledge, a desire which is most advantageously associated with a conviction of ignorance. Sir William Tilden further urged the necessity of the thorough understanding of the subjects taught at each stage of progress, and pointed out that students should not look to their teachers for recipes for doing things, but to their own efforts, as the means of acquiring a full understanding of their work, and that they should not omit becoming fully conversant with the history and meaning of the expressions and words employed in their studies. In conclusion, it was pointed out that with every student there are times when the mind should be allowed to relax a little from the pages of their text-books, and that of the many forms of relaxation it was most desirable that all young English men and women should devote some attention and interest to the history of their own country. The exceptional advantages of London, and especially of the City of London, as a stimulant to such study was particularly referred to, for there is nothing more interesting, more absorbing, or more enchanting than the study of the history of mankind, especially that particular variety of mankind which is represented by the Anglo-Saxon race. Sir William Tilden subsequently opened the new chemistry laboratory which has recently been equipped by the governors of the institute.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, November 24.—Sir Archibald Geikie, K.C.B., president, followed by Mr. A. B. Kempe, vice-president, in the chair.—Sir Norman **Lockyer**: The sequence of chemical forms in stellar spectra.—A. **Mallock**: Influence of viscosity on the stability of the flow of fluids. The effect of this paper is to direct attention to an observation made by the late Mr. W. Froude, F.R.S., with regard to an experiment on fluid jets, and to its application in explaining some of the phenomena presented by the flow of viscous fluids. The experiment referred to was shown by Froude at the British meeting of the British Association in 1875, and one of the deductions drawn from it was that in a viscous flow the character of the stream differed according as to whether the flow was towards decreasing or increasing pressure.—Horace **Lamb**: Atmospheric oscillations. The paper treats of the free oscillations of an atmosphere, the temperature being a function of the altitude, and the adiabatic laws of expansion being assumed. In particular, the case of a uniform temperature gradient is discussed in some detail. The possible oscillations are of various types, of which the most important is of the character of a longitudinal wave. The results are simplest when the equilibrium state is one of convective equilibrium, and the velocity of the longitudinal wave is then equal to the Newtonian velocity of sound, $\sqrt{(gH)}$, corresponding to the temperature of the lowest stratum. The bearing of the results on Kelvin's theory of the semi-diurnal barometric oscillation is examined, and it appears that the existence of a free period of the earth's atmosphere, of somewhat less than twelve mean solar hours, is highly probable. Other types of oscillation depend for their frequency on the degree of stability of the atmosphere, and may in circumstances be comparatively slow. It is possible that these may account for some of the minor fluctuations of the barometer. The paper includes also an examination of the theory of waves at a surface of discontinuity.—P. J. **Kirkby**: A theory of the chemical action of the electric discharge in electrolytic gas and other gases. The complicated results attending the passage of an electric discharge through electrolytic gas, described in previous papers, and in particular the chemical effects observed in the positive columns of long discharges, were explained by the theory that the chemical action is due to molecular dissociation effected by the collisions of gaseous ions constituting the current with the molecules of the gas, the atoms of which are thus set free to enter into new combinations. In this paper an account is given of experiments designed to determine both the number of molecules of water (w) formed by the passage of the atomic charge through 1 cm. of the positive columns of various discharges passed through electrolytic gas ($2H_2+O_2$), and also the electric force (Y) within these columns, the results providing data for testing and developing the theory. The chemical effects of the positive column are attributed to the motion of the electrons alone. The number of atoms of oxygen set free by the collisions of an electron moving through 1 cm. in electrolytic gas at p mm. pressure under the electric force Y is of the form $cpe^{-bp/Y}$, where c, b are certain constants. Hence, if an atom of oxygen can unite directly with a *molecule* of hydrogen, w is proportional to $cpe^{-bp/Y}$. All the experimental results satisfy this condition within error-limits in the particular form $w/p=7{\cdot}9\,e^{-42{\cdot}7p/Y}$, and thus support the above theory as well as the hypothesis that water-vapour is formed by the collision of an atom of oxygen with a molecule of hydrogen. This equation involves that the energy of formation of an oxygen molecule is less than, and probably nearly equal to, $6{\cdot}\times10^{-12}$ ergs; and experiments of Berthelot upon the heat of transformation of ozone into oxygen are shown to be in fair agreement. An estimate, 7×10^{-12} ergs, is also given for the energy of formation of a molecule of water vapour. These experiments also prove, independently of theory, that dissociated atoms of oxygen are not charged electrically. Similar experiments were made with the gaseous mixture $CO+H_2$. The chemical effects observed in the positive column reproduce the main features observed with electrolytic gas, and are explainable by a similar theory.—G. W. **Walker**: An electrostatic voltmeter for photographic recording of the atmospheric potential. The paper describes some experiments made at Eskdalemuir Observatory with the object of obtaining a simple and efficient voltmeter for continuous photographic registration of the electrical potential at a fixed point in the atmosphere. Experience has shown that occasionally the instrument would require to register up to fully 1000 volts + or −. Satisfactory results have been obtained by means of a Dolezalek electrometer. The usual sensitiveness was greatly reduced by using a phosphor-bronze suspension, while the needle was loaded to prevent tilting. A fixed difference of potential is applied between the quadrants by means of one or two standard cadmium cells, while the potential to be measured is applied to the needle. The needle can now carry 1100 volts with perfect safety and stability, while the scale value on the paper is constant to within a few per cent. over a range from −900 to +900 volts. Trial has been made of a voltmeter (made in the workshop) similar in general design to the Dolezalek, but in which the fixed difference of potential between the quadrants is provided by making the quadrants alternately of copper and zinc soldered together and not insulated. Uniformity of scale value has been obtained from about −500 to +500 volts, but for higher potentials only approximate uniformity was secured. This defect arises from want of mechanical perfection of the quadrants and needle, and should disappear in an instrument made with the same accuracy as the Dolezalek. At present, also, the damping of the needle during very rapid changes of potential is insufficient. Reference is made to certain points in the manipulation of sulphur for insulating, which have been found essential to secure good results.—Dr. T. H. **Havelock**: Optical dispersion: an analysis of its actual dependence upon physical conditions. The paper is based upon a generalised dispersion formula

$$\frac{1}{\sigma + 1/(n^2 - 1)} \cdot \frac{1}{P} = \Sigma \frac{c_s}{\lambda^2 - \lambda^2_s}$$

where P is the density of the medium. The quantities c_s and λ_s refer to natural vibrations inherent in the molecule, and it is assumed that these are not changed by varying physical conditions, such as temperature, pressure, or density; thus an attempt is made to express these conditions in their optical effect by two variables, P and σ, The scheme is tested first by a relation deduced from the above formula, namely, the difference in value of $P/(n^2-1)$ for any two physical conditions of the same substance is constant in regard to wave-length. From an examination of available data this appears to be satisfied approximately for gases and liquids and for changes from gas to liquid. Numerical values of σ for various substances in different conditions are obtained by assigning it zero value for the gaseous condition at normal pressure and temperature. Artificial double refraction is included in the same formal scheme by allowing anisotropic changes of the quantity σ. Finally, for dispersion formulæ of the above type an observed maximum of absorption (or of selective reflection) is identified, not with λ_s, but with a wave-length λ'_s, differing from λ_s by a term involving P and σ; numerical examples are given for rock-salt and fluorite. The wave-lengths λ'_s are calculated under various conditions for certain substances; experimental data are analysed to show the pressure-displacement for air and the temperature-displacement of absorption maxima for water and carbon disulphide.—C. P. **Butler**: The spectrum of Halley's comet. Provision was made for photographing the comet and its spectrum from the beginning of May at Fosterdown, Caterham. Exceptionally bad weather prevented observations until the end of the month, when photographs and visual observations of the spectrum were obtained on May 23 and 26. The photographs of the comet taken with a Dallmeyer lens, 6 inches aperture, 50 inches focus, show that the nucleus was at times multiple. Visual observations of the nucleus showed strong continuous spectrum with three bands in the yellow-green, green, and greenish-blue, having approximate wave-lengths 5635 (int. 7), 5165 (int. 10), 4737 (int. 7). The spectrum of the coma surrounding the nucleus consisted of these same three bands, without any indication of continuous radiation. The photographic spectra show only the brightest spectra features of the spectrum of the nucleus, the relative intensities differing widely from the visual intensities owing to the selective sensitiveness of the plates. The two most conspicuous bands are near λ 4737 (int. 10) and 3884 (int. 6), with fainter bands near λλ 4050, 4360, 5165, and 5635. Photographs obtained elsewhere at different times show differences in the relative intensities of the component bands. This has been ascribed to variations of atmospheric absorption. It may be noted, however, that before and after the transit of May 19 the aspect of the head would vary quickly; at one time the hotter side facing the sun would be best seen, at others the cooler portions away from the sun would be more prominent. Preliminary experiments show that by varying conditions of vaporisation the relative intensities of the carbon or hydrogen bands may be considerably modified, and it would appear that the changes observed in the cometary spectrum might be produced by some such difference of condition.—Dr. H. F. **Baker**: A geometrical proof of the theorem of a double six of straight lines.

Edinburgh.

Royal Society, November 7.—Prof. Crum Brown, vice-president, in the chair.—J. D. Hamilton **Dickson**: A thermoelectric diagram from −200° to +100° C., based on the experiments of Sir James Dewar and Prof. Fleming. The platinum temperatures were first reduced to absolute scale. The observations of the electromotive force of each metal-lead couple were plotted against temperature, and the curves were drawn freehand with the greatest care through them. By finding the locus of the middle points of parallel chords, Mr. Dickson proved that the curves were all, with one exception, parabolas. The exception was in the case of antimony-lead, for which the curve was a hyperbola. In the majority of cases the parabolas differed from those obtained by Tait through the more limited range of temperature used by him and his students in the main fact that their axes were not perpendicular to the temperature axis. The "Tait lines," as it was convenient to name the lines of thermoelectric power, were not in these straight, although limited portions of them might be very nearly so. As was easily proved from the geometry of the parabola with inclined axis, each Tait line was a curve with two asymptotes perpendicular to one another. Of the metals investigated, gold, silver, zinc, and German silver followed Tait's rule, the thermoelectric powers referred to the lead line giving straight lines; but platinum, copper, cadmium, nickel, manganese, palladium, and aluminium gave for their electromotive-force curves parabolas with inclined axes. Similar results were obtained from recent observations published by Holborn and Wien, Barus, and from early observations by J. Murray and J. C. Young, working under Tait's directions.—Profs. Alex. **Smith** and A. W. C. **Menzies**: A dynamic method for measuring vapour pressures, with its application to benzene and ammonium chloride. A modified form of the isoteniscope, previously described, was used in determining the vapour pressures of these substances. The advantages of the new form of apparatus were that it could be used for high pressures, that the confining fluid could be reduced in amount, and that the thermometer was inserted directly in the bath with its bulb no longer in a region of varying pressure.—Profs. Alex. **Smith** and W. C. **Menzies**: A quantitative study of the constitution of calomel vapour. The object of the investigation was to find to what extent the vapour of calomel was dissociated, and the method was to measure the vapour pressures by means of the isoteniscope at various temperatures from 360° C. to 400° C. The results showed (1) that the vapour of calomel was composed wholly of mercury and corrosive sublimate, HgCl and HgCl being alike absent; (2) that calomel dissolves in mercury with a molecular weight corresponding to the formula HgCl; (3) that the isoteniscope may be used in the quantitative investigation of chemical problems.—Dr. R. A. **Houston**: The efficiency of metallic filament lamps. The results were obtained by means of a new method involving the examination with a thermopile and very sensitive galvanometer of the spectrum of the radiation transmitted by a water filter. The values obtained for the efficiencies of carbon, osmium, tantalum, and tungsten lamps as energy transformers were respectively 2·9, 5·2, 6·5, and 7·5 per cent.

Paris.

Academy of Sciences, November 21.—M. Émile Picard in the chair.—H. Lorentz was elected a foreign associate in the place of the late Prof. Schiaparelli.—Lord Avebury was elected a correspondant for the section of anatomy and zoology, in the place of Sir Ray Lankester, elected foreign associate.—G. **Fayet**: The identity of the Cerulli comet with the Faye comet. The elements calculated for the two comets are nearly identical, the slight difference noted being probably due to the fact that the considerable disturbance of the orbit of the Faye comet caused by Jupiter in 1899 was only approximately allowed for.—C. **Popovici**: Observation of the Cerulli-Faye comet. Data are given for November 22.—G. **Tzitzéica**: A theorem of M. Darboux.—W. **Stekloff**: A new application of the method of development of fundamental functions.—Paul **Lévy**: The integrability of the equations defining line functions.—G. **Eiffel**: The resistance of rectangular planes struck obliquely by the wind. Experiments were carried out with a suction fan, using a 70 horse-power motor, giving an air current of 10 to 20 metres per second in a tube of 1·5 metres diameter. The results are given graphically in a series of curves.—Jean **Becquerel**: The reversal of the phosphorescence bands. Rubies and an emerald were used for these experiments at the temperature of liquid air. The reversal establishes a qualitative relation between the emission and absorption, and some quantitative relations are worked out.—R. **Jouaust**: The magnetic properties of iron at high frequencies. The iron was used in sheet form, the alternating current, produced by a Poulsen arc, having a frequency of 150,000 per second. The losses observed are 20 per cent. higher than those calculated from J. J. Thomson's formula.—Frédéric **Reverdin** and Armand **de Luc**: The comparative nitration of mono- and dialkylated amines.—L. H. **Philippe**: The glucodeconic acids. The author has extended E. Fischer's synthesis of gluconose to the next higher homologue, glucodecose. In the present paper the preparation and properties of the glucodeconic acids are described.—G. **Friedel** and F. **Grandjean**: Anisotropic liquids. A discussion of the meaning of some experiments recently described by M. Mauguin on the optical properties of azoxyphenetol. The authors regard the term *anisotropic liquids* as being preferable to *liquid crystals*. Marin **Molliard**: The mode of action of the intensity of illumination in the formation of cleistomamic flowers.—P. A. **Dangeard**: A marine alga from the Concarneau Laboratory.—M. **Ringelmann**: Experiments on the yield of juice from the cider press.—Armand **Dehorne**: The coexistence of division and a subdivision of chromosomes in a quiescent state.—Paul **de Beauchamp**: A new gregarian of the genus Porospora.—A. **Gruvel**: The lampreys of the western coast of Africa and their commercial possibilities.—J. **Chatanay**: A remarkable anomaly of *Zonabris variabilis v. Sturmi*.—A. **Fernbach**: The biological degradation of the carbohydrates. Macerations of *Tyrothrix tenuis* act upon starch, maltose, dextrose, or saccharine, and dioxyacetone, glyceric aldehyde, and methylglyoxal have been recognised among the products of the reaction. Formaldehyde and acetaldehyde are also produced by this organism.—J. **Effront**: The action of the Bulgarian ferment upon proteid and amido substances. The Bulgarian ferment rapidly destroys albuminoid material, removing the nitrogen in the form of ammonia, and it is possible that the favourable action of the ferment in gastro-intestinal affections is due to this action instead of to the production of lactic acid.—P. **Chaussée**: The production of primitive thoracic tuberculosis in cattle by the inhalation of infinitesimal amounts of bovine tuberculous material. These experiments prove the possibility of direct infection of the lungs by the inhalation of minute proportions of tuberculous material. In all the cases the mesenteric and cervical ganglia were examined for tubercular infection with negative results.—Jacques **Deprat**: Seismic activity in southern Yun-nan in 1909.

DIARY OF SOCIETIES.

THURSDAY, December 8.

Royal Society, at 4.30.—Colour-blindness and the Trichromatic Theory. Part II. Incomplete Red or Green Blindness: Sir W. de W. Abney, K.C.B., F.R.S.—On the Sensibility of the Eye to Variations of Wavelength in the Yellow Region of the Spectrum: Lord Rayleigh. O.M., F.R.S.—(1) Trypanosome Diseases of Domestic Animals in Uganda. IV. *Trypanosoma uniforme*, sp. nov.; (2) Trypanosome Diseases of Domestic Animals in Uganda. V. *Trypanosoma nanum*. (Laveran): Colonel Sir D. Bruce, C.B., F.R.S., and others.—Some Enumerative Studies on Malarial Fever: Major R. Ross, C.B., F.R.S., and D. Thomson.—On Hæmoglobin Metabolism in Malarial Fever: G. C. E. Simpson.—A Case of Sleeping Sickness studied by precise Enumerative Methods. Further Observations: Major R. Ross, C.B., F.R.S., and D. Thomson.—Enumerative Studies on *Trypanosoma gambiense* and *Trypanosoma rhodiense* in Rats, Guinea-pigs, and Rabbits; Periodic Variations disclosed: Dr. H. B. Fantham and J. G. Thomson.—The Life History of *Trypanosoma gambiense* and *Trypanosoma rhodiense* as seen in Rats and Guinea-pigs: Dr. H. B. Fantham.—Experiments on the Treatment of Animals infected with Trypanosomes, by means of Atoxyl, Vaccines, Cold, X-rays, and Leucocytic Extract; Enumerative Methods employed: Major R. Ross, C.B., F.R.S., and J. G. Thomson.

Mathematical Society, at 5.30.—(1) Properties of Logarithmico-exponential Functions; (2) Some Results concerning the Increase of Functions defined by an Algebraic Differential Equation of the First Degree: G. H. Hardy.—Optical Geometry of Motion: A. A. Robb.—(1) Note on the Pellian Equation; (2) A Property of the Number 7: T. C. Lewis.—On the Arithmetical Theory of Binary Cubic Forms: G. B. Mathews.

Institution of Electrical Engineers, at 8.—The Magnetic Properties of Iron and its Alloys in Intense Fields: Sir R. Hadfield, F.R.S., and Prof. B. Hopkinson, F.R.S.

FRIDAY, December 9.

Royal Astronomical Society, at 5.—The Determination of Selenographic Positions and the Measurement of Lunar Photographs. Fifth Paper: Results of the Measurement of Two Yerkes Negatives: S. A. Saunders.—Note on an Erroneous Formula employed in the Tables of the Four Great Satellites of Jupiter: R. A. Sampson.—On the Accuracy of the Positions of the Star Images in the "Harvard Sky": H. H. Turner.—On Multiple Solutions in the Determination of Orbits from Three Observations: C. V. L. Charlier.—Occultations of Stars observed during the Eclipse of the Moon, Nov. 16, 1910: Cambridge Observatory.—The Equatorial Current of Jupiter in 1886: A. Stanley Williams.—(1) Photographic and Visual Observations of Halley's Comet (1909*c*), Daniel's Comet (1909*e*), and Comet 1910*a*, made at the Radcliffe Observatory, Oxford; (2) Observations of Stars Occulted by the Moon during the Eclipse of Nov. 16, 1910, at the Radcliffe Observatory, Oxford: A. A. Rambant.

Illuminating Engineering Society, at 8.—Recent Progress in Electric Lighting: Prof. E. W. Marchant.

MONDAY, December 12.

Royal Society of Arts, at 8.—Industrial Pyrometry: C. R. Darling.

TUESDAY, December 13.

Royal Anthropological Institute, at 8.15.—Some Unexplored Routes between Angora and Eregli: R. Campbell Thompson.

Zoological Society, at 8.30.—Report of the International Commission on Zoological Nomenclature presented to the Graz Meeting of the International Zoological Congress, 1910: Dr. W. E. Hoyle.—On the Segmentation of the Occipital Region of the Head in the Batrachia Urodela: E. S. Goodrich, F.R.S.—On the Structure and Function of the Gas-glands and Retia Mirabilia associated with the Gas-bladder of some Teleostean Fishes, with notes on the Teleost Pancreas: Dr. W. N. F. Woodland.—The Mammals of the Tenth Edition of Linnæus: an attempt to fix the Types of the Genera and the exact Bases and Localities of the Species: Oldfield Thomas, F.R.S.

Institution of Civil Engineers, at 8.—*Further discussion*: Portland Cement, and the Question of its Aëration: H. K. G. Bamber.

Faraday Society, at 8.—Separation of Oxygen by Cold: J. Swinburns, F.R.S.—New Apparatus for the Rapid Electro-analytical Determination of Metals: Dr. H. J. S. Sand and W. M. Smalley.

WEDNESDAY, December 14.

Royal Society of Arts, at 8.—A New View of Roman London: Reginald A. Smith.

Junior Institution of Engineers, at 7.30.—Some Recent Developments in Condensing Plant: G. L. Kothny.

THURSDAY, December 15.

Linnean Society, at 8.—Reports on the International Botanical Congress at Brussels, 1910: Dr. Otto Stapf, F.R.S., and others.—Non-calcareous Sponges from the Red Sea, collected by Mr. Cyril Crossland: R. W. H. Row.—Comparative Anatomy of Leaves of Veronica: R. S. Adamson.

Royal Society of Arts, at 4.30.—The Taj Mahal and its Relation to Indian Architecture: R. F. Chisholm.

Institution of Electrical Engineers, at 8.—Submarine Cables for Long Distance Telephone Circuits: Major W. A. J. O'Meara, C.M.G.

FRIDAY, December 16.

Institution of Mechanical Engineers, at 8.—The Production of Castings to withstand High Pressures: Prof. H. C. H. Carpenter and C. A. Edwards.—The Constitution of Troostite and the Tempering of Steel: Andrew McCance.

Institution of Civil Engineers, at 8.—Mathematical Deduction of the most Economical Ratio of Reinforcement for Reinforced-concrete Structures: R. N. Mirza.

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